



SAFETY PROGRAM:

Thermal (Heat-Cold Related) Stress

(June 2010)

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PURPOSE

Proactive measures are to be considered in preventing thermal (heat/cold) related illnesses and injury when employees are to work in increasingly extreme temperature situations. The purpose of this Thermal Stress Guidance is to provide recommended methods to protect employees whose work exposes them to dangerous weather conditions that can lead to a heat-related illness (heat rash, heat cramps, heat exhaustion or, the most serious, heat stroke (hyperthermia) for hot work environments; and hypothermia and frostbite for cold work environments), or heat stress-related accidents.

SCOPE

Many work tasks must be completed in extremes of heat and cold.

1. For employees of the South Carolina Budget and Control Board, this guidance applies whenever there is a high heat index, typically during the months of May through early September and especially for those working in the outdoors. However, a high heat index may also be applicable to work being done in other hot and humid environments such as in boiler rooms or utility tunnels particularly during the winter months where burns may also occur as a result of accidental contact with hot surfaces or steam.
 - a. There are a number of heat stress indexes available to determine the degree of hazard but no single one is universally used. The wet-bulb globe temperature method is a comprehensive index which factors in radiation, evaporative cooling, clothing type, and work demands on acclimatized or un-acclimatized workers. However, a more practical indicator for predicting weather-related heat stress is the National Weather Service Heat Index that calculates an apparent temperature based on temperature and humidity.

National Weather Service Heat Index
(National Oceanic and Atmospheric Administration)

		Temperature (°F)																
		80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110	
Relative Humidity (%)	40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136	
	45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137		
	50	81	83	85	88	91	95	99	103	108	113	118	124	131	137			
	55	81	84	86	89	93	97	101	106	112	117	124	130	137				
	60	82	84	88	91	95	100	105	110	116	123	129	137					
	65	82	85	89	93	98	103	108	114	121	128	136						
	70	83	86	90	95	100	105	112	119	126	134							
	75	84	88	92	97	103	109	116	124	132								
	80	84	89	94	100	106	113	121	129									
	85	85	90	96	102	110	117	126	135									
	90	86	91	98	105	113	122	131										
	95	86	93	100	108	117	127											
100	87	95	103	112	121	132												

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

 Caution
 Extreme Caution
 Danger
 Extreme Danger

Directions for Using the Heat Index Chart: Find where the current humidity (row) and temperature (column) intersect to find the Heat Index ("Real Feel" temperature).

Example 1: If it is 82° F with 90% humidity, the Heat Index is 91°, which is in the Extreme Caution range.

Example 2: If it is 90° F with 95% humidity, the Heat Index is 127°, which is in the Extreme Danger range.

- b. A study conducted by the National Institute for Occupational Safety and Health also links the signs of heat stress, i.e., lower mental alertness and physical performance, to an increase in workplace accidents. For instance, sweaty palms, fogged-up safety glasses or dizziness can result in dropped equipment, placing a hand or tool in a hazardous location (because one could not clearly see the work), and falls.
2. Columbia SC rarely has temperatures and wind speed combinations that create the cold stress-related illnesses of hypothermia (core body temperature below 95° F) and frostbite (frozen skin tissue). However, for employees that work outside, wind chill values are a useful tool in determining the need for insulated (thick or layered) outer garments, hats and gloves.



NWS Windchill Chart



		Temperature (°F)																				
	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45			
Wind (mph)	5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63			
	10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72			
	15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77			
	20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81			
	25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84			
	30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87			
	35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89			
	40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91			
	45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93			
	50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95			
	55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97			
	60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98			

Frostbite Times

30 minutes

10 minutes

5 minutes

Wind Chill (°F) = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Directions for Using the Wind Chill Chart: Find where the current prevailing wind speed (row) and temperature (column) intersect to find the Wind Chill ("Real Feel" temperature).

Example: If it is 20° F with a 20 mph wind, the Wind Chill is 4°.

PROCEDURES

Effective measures to prevent heat-related illnesses vary by team, job duties and the work environment. Because each situation is different, a list of measures follows.

- Training:** BCB Safety is to provide training to all employees with potential exposure so they understand what heat-related illnesses are, their signs and symptoms, how heat affects their health and safety, and company policy to prevent thermal stress. Training is to include procedures in this policy.
 - Employees routinely exposed to work outside in the summer heat (i.e., Building Maintenance, Building Systems, Horticulture) are required to take a one-time (on-line) course that focuses on recognizing and caring for hot weather related illnesses.
 - Additionally, many of these and other employees required to have First Aid-CPR training (certification is every two years) also learn to recognize and care for hot and cold weather related illnesses and injuries.
- Environmental factors** that contribute to the risk of a heat-related illness include.
 - Air temperature and humidity (see the National Weather Service Heat Index and Wind Chill Chart)
 - Air movement (wind velocity)
 - Radiant Heat, i.e., reflection of heat from asphalt, rocks, or composite roofing material, or working in direct sunlight or near a furnace.
- Personal factors** that increase the body's susceptibility to a heat-related illness includes but is not limited to an individual's:
 - Age, weight, previous heat stress injury, underlying medical conditions (i.e., diabetes, cardiovascular disorders, chronic pulmonary disease, thyroid disorders), and overall health and physical fitness.
 - Use of caffeine, nicotine and medications that make one more sensitive to heat or cold such as:
 - Allergy medicines (antihistamines)
 - Cough and cold medicines
 - Blood pressure and heart medicines
 - Irritable bladder or bowel medicines

- v. Laxatives
- vi. Mental health medicines
- vii. Seizure medicines
- viii. Thyroid pills
- ix. Water pills (diuretics)

Example: Workers at greater risk of thermal stress include those who are 65 years of age or older, are overweight, have a temporary infection and/or heart disease or high blood pressure, or take medications that may be affected by extreme heat.

4. **Work-Rest Regimen:** Thermal stress is influenced by work rate, level and duration of physical exertion (i.e., hand sawing or digging with a shovel versus using a power saw or trencher). Such physical work requires acclimatization and rest periods.
 - a. Heat related illness might result at temperatures below the cautionary levels or when there is a sudden and significant increase in temperature and humidity.
 - b. Work pacing influences the stress on the body's temperature regulation system. Individual responses to a given work load vary but, as an employee expends more energy, the body's internal temperature rises stressing the cardiovascular system to regulate body temperature by increasing blood flow to the skin (convection) and sweating (evaporative cooling).
 - c. Limiting worker exposure to periods of high heat index can be accomplished in several ways.
 - i. Acclimatization: Employees, especially new hires and those returning from extended vacation or illness, need three to five days to adapt to hotter temperatures starting with a light work load and progressively increasing work load to 100 percent.
 - ii. Establish (summer) work hours that begin and end earlier in the day, i.e., instead of working from 8:00 a.m. to 4:30 p.m., work from 6:30 a.m. to 3:00 p.m.
 - iii. Schedule more stressful work in the mornings, i.e., prior to 10:00 a.m., before it gets too hot, or at night. Reduce the severity of work by scheduling slower paced, less physically demanding work during the hot parts of the day. The hottest times of the day to avoid if possible are from 1:00 to 4:00 p.m.
 - iv. Where work sites are in direct sun light and when there is a lengthy exposure to a high heat index, employees may erect a temporary shelter to provide shade for the work area.
 - v. Pacing: Allow/schedule more frequent and/or longer rest breaks or rotate workers more frequently in shorter job work shifts when there is an elevated heat index and/or the more strenuous the work becomes to limit the time each employee spends in the heat. Breaks should be even more frequent when workers wear non-permeable ensembles.
NOTE: Break areas are to be either indoors, in a naturally shaded area or in shade provided by a shelter immediately adjacent/readily available to the work site. Cooling fans are also recommended.
 - vi. Consider work stoppage whenever the heat index is 120° F or higher – approaches or is the Extreme Danger range.
5. **Hydration:** Employees performing moderate activities in hot environments may need at least a quart (4 cups) of water per hour and 6-8 quarts of water per day; employees performing heavy work in hot environments may need 9-12 quarts of water per day.

- a. Thirst is not an accurate indicator of the body's need for hydration and should not be used as a guide for fluid replacement. Relying on thirst alone leads to dehydration, the precursor to heat related illness.
- b. It is important to establish drinking schedules and encourage frequent and regular drinking of small quantities of water or other acceptable beverages.
 - i. Drinking water packaged as a consumer product and/or electrolyte-replenishing beverages without caffeine, sugar or alcohol, such as "sports" drinks, are acceptable.
 - ii. Example of Scheduled Hydration: Employees should drink a cup of water:
 - 1) every 20-30 minutes for a medium (Caution) heat index,
 - 2) every 15-20 minutes for a moderate (Extreme Caution) heat index,
 - 3) every 10-15 minutes for a high (Danger or Extreme Danger) heat index.

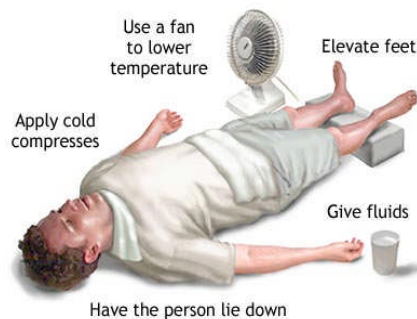
Note: Water is to be similarly provided for customers or the general public who attend special events such as auction days at Surplus Property or vendor fairs.

- c. Potable water can be obtained from water fountains but when not readily available can be provided in a cool and sufficient quantity using portable containers readily accessible at work sites. Replenishment of the water supply during the day may be required, especially as the temperature increases. Individual drinking (disposable) cups should also be provided.
6. **Clothing and Personal Protective Equipment (PPE):** When selecting work attire and/or PPE, management must keep in mind that while providing protection against one hazard it can simultaneously contribute to the potential for heat stress. Permeability, weight, fit and ventilation factors affect the body's ability to regulate its internal temperature. In a hot environment, heat must be dissipated while preventing heat gain from the environment. In a cold environment, heat must be conserved.
- a. For purposes of comfort, work uniforms should be appropriately selected for the season, i.e., short-sleeved work shirts and possibly work shorts may be allowed when the work has no hazards other than a high heat index. This increases the danger from direct sun on exposed skin which can be blocked out by wearing a wide brim hat, sunglasses and sun screen. Employees can also wear cooling vests or headbands.
 - b. Concurrently, the employee must wear appropriate PPE to protect against workplace environmental and work process hazards when exposed. For instance, fire resistant long-sleeved shirts and slacks and PPE required to be worn when working on electrical equipment or welding, and chemical resistant PPE required when mixing or using certain chemical products (such as spraying pesticides) adds inherent weight while lowering permeability. In addition to causing an increased metabolic heat gain, workers have increased risk of heat stress caused by wearing the PPE which substantially limits convective and evaporative cooling resulting in a rapidly increased body core temperature. Because PPE must be worn, an option is to reduce exposure by adjusting the employee's work schedule to allow work in heat risk environments, and to remove the PPE during break periods.
 - c. Multiple layers of thin and loose-fitting clothing are recommended especially during seasonal changes with large and rapid temperature changes. Workers can subtract or add layers to match the temperature and stay comfortable.
7. **Response to Heat-Related Illness:** Recognizing and taking prompt actions are critical to prevent heat-related illness (as heat stress can rapidly advance to heat stroke). Employees experiencing signs and symptoms of a heat-related illness are to cease work, report their condition to their supervisor, and have appropriate emergency response care to include

calling 9-1-1 for emergency medical services as indicated in the following chart. The quicker any employee experiencing symptoms can be treated, the better the chances are for a full recovery.

Heat-Related Illness	Signs and Symptoms	Emergency Response
Sunburn	<ul style="list-style-type: none"> Red, hot skin Possibly blisters 	<ul style="list-style-type: none"> Move to shade, loosen clothes Apply cool compress or water to burn Get medical evaluation if severe
Heat Contact Burn	<p><u>MINOR BURN:</u></p> <ul style="list-style-type: none"> 1st Degree - outer layer of skin is red, with swelling and pain 2nd Degree – the first layer of skin has been burned through and the second layer of skin (dermis) also is burned with blisters; intensely reddened, splotchy appearance; severe pain and swelling <p><u>MAJOR BURN (3rd Degree):</u></p> <ul style="list-style-type: none"> Areas may be charred black or appear dry and white 	<p><u>MINOR BURN:</u></p> <ul style="list-style-type: none"> Cool with cold water or cold compresses (not ice) Pat dry and cover with a sterile gauze and loose bandage Do not put on ointment, butter, oil Do not break blisters If infection develops, see doctor <p><u>MAJOR BURN (3rd Degree):</u></p> <ul style="list-style-type: none"> Call 911 if it involves substantial portions of the hands, feet, face, groin or buttocks, or a major joint; or an electrical injury Do not remove burnt clothing Elevate burned body part(s) above heart level Cover burn with cool, moist, sterile bandage
Heat Rash	<ul style="list-style-type: none"> Red, itchy skin Bumpy skin Skin infection 	<ul style="list-style-type: none"> Apply cool water or compress to rash Keep affected area dry
Dehydration	<ul style="list-style-type: none"> Loss of work capacity Delayed response to stimuli Fatigue, Weakness Dry mouth 	<ul style="list-style-type: none"> Drink water to hydrate body Rest in a cool, shaded area
Heat Cramps	<ul style="list-style-type: none"> Muscle cramps or spasms (especially in abdomen and lower extremities) Grasping the affected area Abnormal body posture 	<ul style="list-style-type: none"> Drink water to hydrate body Rest in a cool, shaded area Massage affected muscles Get medical attention if cramps persist
Heat Exhaustion	<ul style="list-style-type: none"> High pulse rate, low blood pressure Extreme sweating Excessive thirst, decreased urine output Pale face or flushing Loss of appetite, Nausea Headache Clammy and moist skin Weakness, fatigue Dizziness Confusion, anxiety Body temperature high but less than 104⁰ F 	<ul style="list-style-type: none"> CALL 911 Immediately move to a cool or shady area Loosen or remove tight clothing Start rapid cooling with fan, wet sponge, water mister If conscious, give sips of cool water (no ice) Monitor Administer CPR if needed (and trained)

Heat-Related Illness (cont.)	Signs and Symptoms	Emergency Response
Heat Stroke (Hyperthermia)	<ul style="list-style-type: none"> Any of the above, but more severe Red, hot, dry skin (stopped sweating) Shivering Vomiting (inability to drink) Confusion, disorientation, other strange behavior Can progress to collapse, loss of consciousness and seizures Body temperature 104° F or higher 	<ul style="list-style-type: none"> CALL 911 Immediately move to a cool or shady area Loosen or remove tight clothing Start rapid cooling with fan, wet sponge, water mister Lay flat and elevate feet If conscious, give sips of cool water (no ice) Monitor Administer CPR if needed (and trained)



If a worker can't answer these questions, assume it is heat stroke.

1. "What is your name?"
2. "What day is this?"
3. "Where are we?"

Heat-Related Illness (cont.)	Signs and Symptoms	Emergency Response
Cold-Contact Burn/Frostbite (frozen skin tissue)	<ul style="list-style-type: none"> Numbness; Painless Skin appears waxy and yellow Skin is swollen and blistering 	<ul style="list-style-type: none"> Remove constrictive clothing Do not rub (causes further tissue damage) Immerse in tepid water (>105° F but < 115° F; never use dry heat) Give warm drinks and food Call 911
Hypothermia	<ul style="list-style-type: none"> Shivering Fatigue, Exhaustion Confusion, Memory Loss Slurred speech Loss of Motor Control 	<ul style="list-style-type: none"> Call 911 Move the victim to warm, dry shelter Remove wet clothing Wrap in warm blankets Provide warm drinks only if able to follow commands and sit up Watch for sudden cardiac arrest; provide CPR, as required and trained

8. **Monitoring:** It is important for supervisors to monitor weather conditions (assisted by Safety) and to adequately assess the appropriate level of work activity that can be performed safely in work environments with extreme temperatures, alert employees to the potential of dangerous temperatures and to remind them of appropriate precautionary procedures.
- a. Issue Heat Alerts: The supervisor has ultimate responsibility for the safety of subordinate employees. Supervisors are to monitor the weather throughout each work day and when “Extreme Caution” conditions or higher (see the National Weather Service Heat Index) are present they are to alert employees and implement their preventive measures for working in high heat index conditions. The alert might include a reminder of signs and symptoms, how to control exposure, and a re-emphasis of the preventive work strategies to be followed.
 - b. Supervisors, coworkers and employees themselves are responsible to monitor for signs and symptoms of heat-related illness. A supervisor or coworker is often in the best position to observe the onset of a heat-related illness in a coworker. Employees can take their own pulse, work with a buddy, and ask each other for self-determinations.

References:

- Occupational Safety and Health Administration:
 - 29 CFR 1910.132 Subpart I – Personal Protective Equipment
 - 29 CFR 1910.141(b)(1) Potable Water
 - OSHA Letter of Interpretation: 10/17/2001 - Acceptable methods to reduce heat stress hazards in the workplace
 - OSHA Publication 3154 (2002) - Heat Stress Card
(<http://www.osha.gov/Publications/osh3154.html>)
 - OSHA Publication 3166 (2003) – Protecting Yourself in the Sun
(<http://www.osha.gov/Publications/OSHA3166/osh3166.html>)
 - Web site: Heat Stress - <http://www.osha.gov/SLTC/heatstress/standards.html>
- American Heart Association Heartsaver First Aid Basic Life Support course
- National Institute for Occupational Safety and Health (NIOSH) Publication No. 86-112: Working in Hot Environments (<http://www.cdc.gov/niosh/hotenvt.html>)
- National Oceanic and Atmospheric Administration’s National Weather Service:
 - Heat Index - <http://www.nws.noaa.gov/om/heat/index.shtml>
 - Wind Chill Chart - <http://www.nws.noaa.gov/om/windchill/>
- “Best Practices - Working in Extreme Temperatures,” Keller On-Line (subscription service)